Voluntary Environmental Corrective Action Program

Offsite Investigation Report

Prepared for:

The Hoover Company

Plant 1, North Canton, OH

November 2000

CH2MHILL

Executive Summary

The results of this investigation were used to characterize the extent of chemical concentrations in groundwater beyond the western property boundary of The Hoover Company's Plant 1 property at 101 East Maple Street, North Canton, Ohio, and to evaluate whether conditions in the area pose concern about human health. While the results show that contaminated groundwater is present in limited offsite areas, the evaluation of results shows that groundwater migrating off Hoover's western property boundary poses no significant risk to human health.

The Offsite Investigation described herein pertains to the area west of the Plant 1 property being investigated as part of Hoover's sitewide Voluntary Environmental Corrective Action Program (VECAP). Hoover initiated the investigation based on previous investigative results that indicated groundwater along part of its western property boundary had been affected by past chemical releases and that further evaluation was needed to determine the potential for that groundwater to migrate off Hoover's property. The following findings are supported by location-specific data used to evaluate the potential scenarios for community members to come in contact with contaminants:

1. There are no private water wells in the study area, and thus there is no potential to drink or come in contact with the contaminated groundwater through a faucet, spigot, or hose.
2. The data show that chemicals are not moving as vapors from groundwater into soil at concentrations that pose a concern for possible continued movement into buildings; thus, this pathway does not pose human health risks that warrant additional evaluation or control measures.
3. Except as noted below, the available information shows that groundwater lies below basement floors and underground utilities; thus, direct contact with contaminated groundwater or inhalation of associated contaminated vapors in buildings, basement sumps, or utility excavations is not occurring.
4. Groundwater is present above parts of the sanitary sewers. It may also be present in the basement sump of a single offsite building. Exposure to contaminated groundwater could occur in those places, but it is unlikely to be significant based on the estimated concentrations and limited frequency and duration of exposure.

Consistent with its longstanding commitment to the community, Hoover will continue to address its environmental issues in a forthright and responsible manner. These actions will help to ensure that human health and the environment are protected and will satisfy Hoover's regulatory obligations within the VECAP.

Contents

Appendices

Tables

Figures

Acronyms

cis-1,2-DCE	cis 1,2-dichloroethene
CVOCs	chlorinated volatile organic compounds
PCE	tetrachloroethene
RCRA	Resource Conservation and Recovery Act
SVOCs	semivolatile organic compounds
TAL	Target Analyte List
TCE	trichloroethene
USEPA	U.S. Environmental Protection Agency
VECAP	Voluntary Environmental Corrective Action Program
VOC	volatile organic compound

Offsite Investigation Glossary of Terms

Chemical. The term is generally used to describe a (chemical) substance that is found in *environmental media,* but does not necessarily represent *contamination.* The term is used interchangeably with the terms "compound" or "constituent."

Contaminated / Contamination. As used throughout this report, *contamination* refers to a chemical substance that is or was present in environmental media at a concentration that exceeds Hoover VECAP *target levels.*

Decision Levels. Decision levels are conservative, risk-based concentrations that are estimated using the specific human health exposure scenarios that are found to exist at the area being studied. They are used to help better define areas of higher concentrations where further evaluation would likely be warranted. These risk-based concentrations were calculated in accordance with guidance developed by the USEPA.

Detection. When a chemical is present in *environmental media* at a concentration that a laboratory instrument can measure.

Downgradient. As generally used throughout this report, this refers to the direction of *groundwater* flow.

Environmental Media. Soil, groundwater, water, or air.

Exceedance. When a *chemical* is *detected* at a concentration greater than a specific *target* or *decision level*

Groundwater. Water that is found below ground which fills the spaces between individual soil particles or within cracks and crevices.

Target levels. These are concentrations of chemicals in groundwater that Hoover uses to help decide the extent of groundwater impacts and to determine whether additional evaluation is needed. Target levels are founded upon published health based standards developed to protect human health under any exposure conditions. Target levels were identified at the start of the VECAP and approved by USEPA. They represent the threshold below which, even if a chemical is detected, is not considered to represent *contamination.*

Upgradient. As generally used throughout this report, this refers to the direction opposite of *groundwater* flow.

Volatilize. The transfer of chemicals from a liquid form (such as in groundwater) to a gaseous form (such as air).

SECTION 1

Introduction

Purpose and Structure of Report

This report documents the purpose for and findings of the Offsite Investigation. The area covered by this investigation generally extends from Hoover's western facility boundary on the east to Willaman Street on the west, and 5th Street on the north to Hower Street on the south (Figure 1-1).

Hoover initiated the Offsite Investigation based on the results of an investigation along its facility boundary (referred to as the Perimeter Investigation) that was completed between November 1999 and February 2000. The goal of the Perimeter Investigation was to understand the soil and groundwater conditions under the property boundary and whether any chemicals from Hoover's past practices had been released into the soil or groundwater. The Perimeter Investigation results indicated that the groundwater along a part of the western boundary of Hoover's property had been affected by past chemical releases, and that further evaluation was needed to determine the potential for this groundwater to migrate off Hoover's property. Hoover conducted the Offsite Investigation to determine if the groundwater moving from beneath its property was affecting areas off of its property.

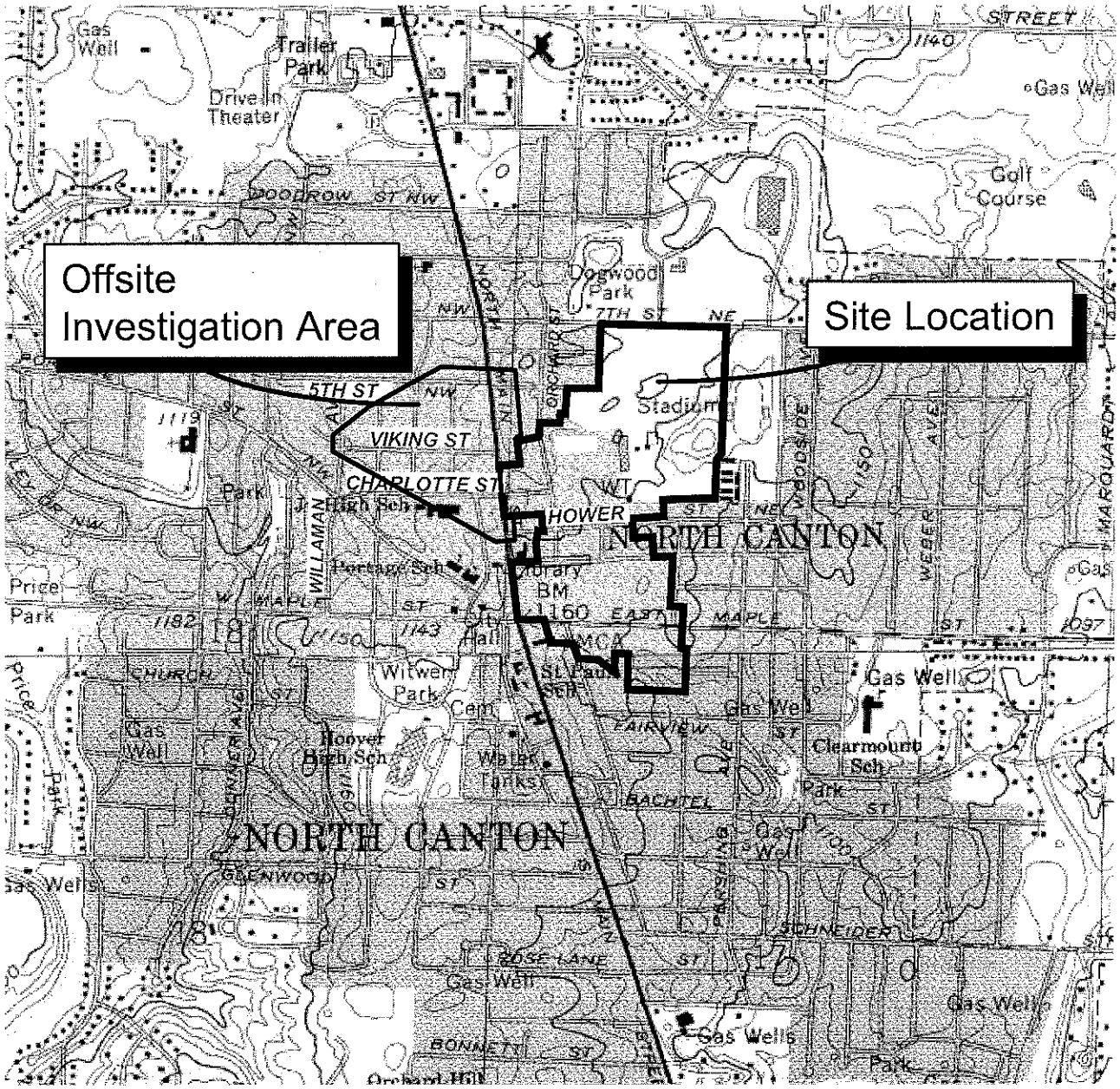
The first part of this report provides a summary of the Offsite Investigation objectives and a historical and regulatory perspective, because the work is being performed as part of a larger program to systematically and comprehensively address environmental issues at the facility. Subsequent sections of the report describe:

- How and why specific parts of the investigation were developed and completed (Section 2, Offsite Investigation Approach)
- The results of the investigation and their meaning (Section 3, Investigation Results)

Several appendices provide supporting information. Appendix A provides an overview of concepts about site conditions and risk for those readers unfamiliar with those concepts. Appendix B, C, D, and E provide further technical information and data. Additional technical documents that provide detailed data summaries or evaluations are not included but are referenced throughout.

Hoover's Manufacturing Background

Hoover's roots in North Canton extend back to 1827, when Henry Hoover settled on a multi-acre parcel of farmland and began a family tannery business. In 1873, Henry's grandson, William, moved that successful business to a facility on the property where Hoover headquarters are now located and began a leather goods business as well. In 1908, W. H. "Boss" Hoover teamed up with local inventor William Spangler to manufacture the electric suction sweeper.



NOTE

Base map adapted from US Geological Survey 7.5 Minute Quadrangle Maps: Canton West, Ohio (revised in 1985) and North Canton, Ohio (revised in 1984).

FIGURE 1-1

Offsite Investigation Location Map

Offsite Investigation Report
The Hoover Company, North Canton, Ohio

CH2MHILL

Antigone\Proj(J:)\Hoover\GIS\Offsite Investigation Location Map.ppt 10/12/00

Between 1907 and 1918, both electric sweepers and leather goods were manufactured at the North Canton site, and by 1919, Hoover was manufacturing the motors to run the sweepers. From the early 1900s to the 1950s, manufacturing operations are believed to have included aluminum die casting, alloying, metal finishing, motor manufacturing, plating, painting, and assembly.

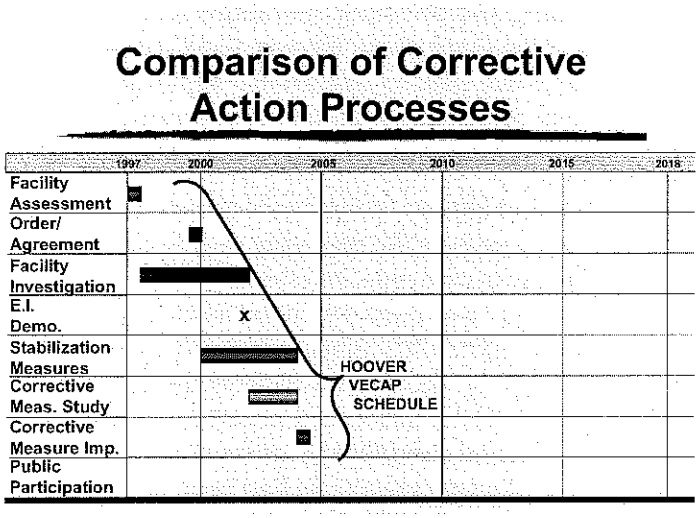
Hoover temporarily halted its consumer products manufacturing during World War II to support the war effort. Parts of the plant were retooled to manufacture switches, fuses, shells, and motors, and plastic and aluminum cast parts for the military. After the war, Hoover reinstated the manufacture of vacuum cleaners and small appliances. During the 1970s and 1980s, metal-forming and finishing operations were the primary parts manufacturing operations at the main plant. Hoover used chlorinated solvents for degreasing and had various metal-plating operations. Although plastic molding processes began in the early 1940s, they did not fully replace the aluminum die casting processes until 1994.

Part of Hoover's facility north of Hower Street has historically been used for maintenance and facility support operations such as the receiving and storage of chemicals and management of wastes. One particular area, referred to throughout this environmental program as the "regulated unit," was used for chemical and waste storage. Hoover has not used the area for drum storage since 1989, when regulated closure (the process of decommissioning and, if necessary, decontaminating an area used to manage hazardous wastes) began, in accordance with the Resource Conservation and Recovery Act (RCRA). As part of that closure process, Hoover completed a series of investigative activities at the facility. These investigations indicated chemicals had been released to the environment.

To further evaluate and address potential environmental issues, Hoover began work toward fulfillment of all of its RCRA obligations, even before the U.S. Environmental Protection Agency (USEPA) required action to be taken. The result of those efforts was the first voluntary RCRA Corrective Action Agreement with USEPA Region 5. The Perimeter Investigation was one of the first steps performed under Hoover's VECAP and immediately preceded the Offsite Investigation. Hoover's implementation of the VECAP demonstrates their commitment to human health and the environment and provides the following overall benefits:

- It fosters an open relationship and involves the North Canton community in the process by communicating vital information, conclusions, and next steps.
- It creates a cooperative atmosphere with the agencies and the community so that concerns and potential conflicts can be addressed in a timely, cost-effective manner.
- It meets the technical and regulatory requirements of the RCRA Corrective Action process, assuring that decisions are based on data of both sufficient quantity and high quality (representative and accurate) to meet the RCRA process.
- It reduces potential long-term liabilities by identifying and mitigating them in a proactive manner.

- It greatly reduces the time typically required in the RCRA process (Figure 1-2).
- It has allowed Hoover to move forward with the evaluation of current potential exposures to human health.



Offsite Investigation Objectives

Hoover initiated the Offsite Investigation to determine if chemicals in groundwater had left their property and, if so, the extent and potential impacts to the community. The Offsite Investigation had the following primary objectives:

- Determine the type and location of Hoover-related chemicals in groundwater beyond Hoover's western property boundary.
- Characterize subsurface conditions that can affect the movement of groundwater and the movement of chemicals in soil, groundwater, soil vapor, or air.
- Identify possible receptors (such as a resident or a worker) of chemicals that might be present offsite, and determine if exposure pathways are likely to be complete. (These concepts are defined and discussed in Appendix A of this report.)
- Collect information that the USEPA would use in determining the acceptability of potential human health exposures.
- Provide additional information needed to evaluate future remedial actions if warranted.

SECTION 2

Offsite Investigation Approach

This section describes the key questions asked and information used to develop the investigation approach. This background information provides the reader with an understanding of why each field activity was initiated and how to understand the investigation data, results, and conclusions presented in Section 3.

Questions to be Answered

Environmental investigations are designed to answer questions about environmental conditions. The Offsite Investigation was designed to answer such questions as these:

- Has the contaminated groundwater along the western edge of Hoover's property migrated offsite?
  - Where is it?
  - How is groundwater moving?
- Is the community being exposed to contaminated groundwater? If so, what does it mean?
- Does Hoover have enough data to respond appropriately? And if not, what else needs to be determined?

Once questions are identified, existing information is gathered and reviewed to see what is known and to determine what new information needs to be gathered. Existing information regarding environmental site conditions would typically include:

- A description of physical conditions, such as soil type or groundwater flow direction
- A summary of how physical conditions influence the way chemicals might move through the environment
- A hypothesis of how a chemical release might move from its source through the environment to potential receptors

In the case of the Offsite Investigation, considerable existing information was used to develop the understanding of site conditions. That information was then used to help determine additional data needs and the Offsite Investigation approach.

Building on the understanding of site conditions (presented in the Perimeter Investigation Report CH2M HILL 2000a), the objectives of the Offsite Investigation (Section 1), and the general questions identified above, the following questions were developed specific to the Offsite Investigation:

- What are the offsite extent (both horizontally and vertically) and concentrations of specific chemicals observed in groundwater at the perimeter of Hoover's property? This identifies the area that needs to be evaluated further (investigation area).

- Are there private wells in the investigation area? It was known that the City of North Canton supplies drinking water to the residents, but confirmation that there are no private wells was needed.
- Are chemicals present in groundwater that could produce vapors at concentrations of concern?
- Is groundwater present in basements in the investigation area?

These questions formed the basis for the activities that were completed as part of the Offsite Investigation (see Appendix B).

Offsite Investigation Approach and Decisionmaking

The approach was to investigate the offsite area in the following general manner:

1. First, using geological and groundwater information, identify areas where groundwater along the western property line would most likely move (e.g., to the west-northwest).
2. Then, collect and analyze groundwater samples for specific chemicals on the Offsite Target Analyte List (TAL; refer to Table 2-1 for a list of the specific chemicals on the TAL). The TAL was developed based on the chemicals detected along parts of the western property boundary at concentrations exceeding groundwater target levels (refer to Appendix C for the rationale used to establish the TAL).

TABLE 2-1
Hoover Offsite Target Analyte List
The Hoover Company— Offsite Investigation Report

Volatile Organic Compounds	Semivolatile Organic Compounds	Metals
cis-1,2-Dichloroethene	2-Methylnaphthalene	Barium
Tetrachloroethene	bis(2-Ethylhexyl)phthalate	Cadmium
Trichloroethene	Naphthalene	Copper
Vinyl Chloride		Lead
trans-1,2-Dichloroethene		Mercury
1,1-Dichloroethene		Nickel
1,1-Dichloroethane		Titanium
		Zinc

3. Evaluate the new information relative to target levels and continue the investigation until the extent of groundwater impacts were thus defined.

   Target levels were identified at the start of the VECAP and approved by USEPA (refer to *Facility-Specific Target Levels – Hoover Voluntary Corrective Action Program* CH2M HILL 2000b). They are concentrations of chemicals in groundwater designed to protect against potential exposures in a residential (the most conservative) setting. Target levels are

used to determine the extent of groundwater impacts and whether additional evaluation is needed.

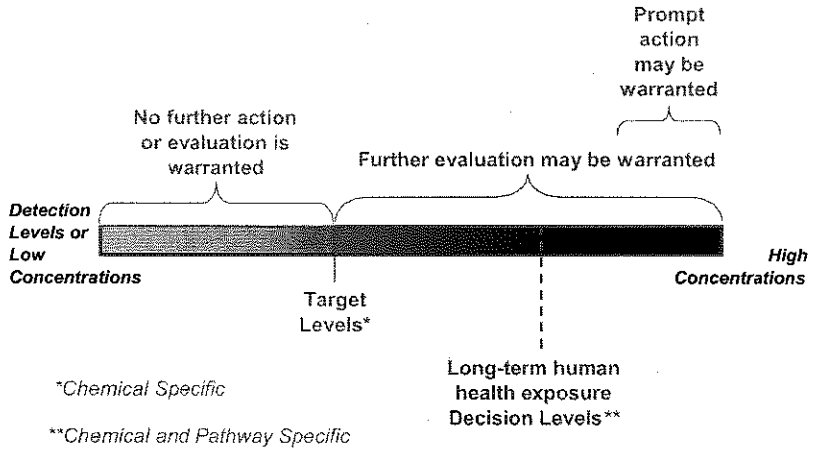
4. If a chemical was detected in groundwater but at a concentration below its target level, then no additional investigations of the extent of that chemical would be performed. If a target level was exceeded, the groundwater chemical data were compared to decision levels to determine whether additional pathway evaluation was necessary.

   Decision levels are concentrations of chemicals that are protective of human health under a given exposure pathway scenario. If they were exceeded, additional evaluation of the pathway was warranted. Decision levels are conservative, risk-based concentrations that are calculated in accordance with guidance developed by the USEPA using exposure scenarios found to exist for the area being studied (refer to the *Documentation of Investigative Decision Levels for the Offsite Groundwater Investigation,* CH2M HILL 2000c).

Target and decision levels are summarized in Appendix D. The relationship between chemical detection, target levels, and decision levels is represented graphically on Figure 2-1. Decision levels for the drinking water (ingestion) pathway were equal to the target levels. Decision levels were established for the following primary pathways:

- **Nonpotable Groundwater Use Pathway.** This pathway involves direct contact with groundwater and incidental ingestion of groundwater (for example, drinking water from a hose while watering the lawn, washing the car, or other recreational activities).
- **Groundwater-to-Indoor-Air Pathway.** Two pathways exist for chemicals to migrate from groundwater to indoor air. To evaluate these pathways, three separate decision levels were developed. The first pathway has two components and decision levels: (1) groundwater to soil gas, and (2) soil gas to indoor air. The second pathway (chemicals migrating directly from groundwater to indoor air, which could only occur if groundwater was in a building) has a decision level for groundwater to indoor air.

FIGURE 2-1
Relationship between Target Levels, Decision Levels, and Relative Concentrations
The Hoover Company – Offsite Investigation Report



As described in Section 3, the Offsite Investigation proceeded systematically outward in the general direction of groundwater flow. Both target and decision level exceedances were used to guide and refine the scope and extent of the investigation. For example, groundwater grab sampling continued until chemicals in groundwater were not detected above target levels. The results of the Offsite Investigation, presented in Section 3, further describe how these screening tools were used.

SECTION 3

Offsite Investigation Results

This section presents the finding of the Offsite Investigation. It begins with a discussion of subsurface conditions and describes why they are important to understanding how groundwater moves. This is followed by a discussion of the locations and concentrations of chemicals detected in groundwater relative to target and decision levels, and the results of soil gas sampling and a survey of residences and businesses. The report concludes with a summary of the investigations findings and an assessment of risk.

Subsurface Conditions and Groundwater Movement

Subsurface Soil and Bedrock Conditions

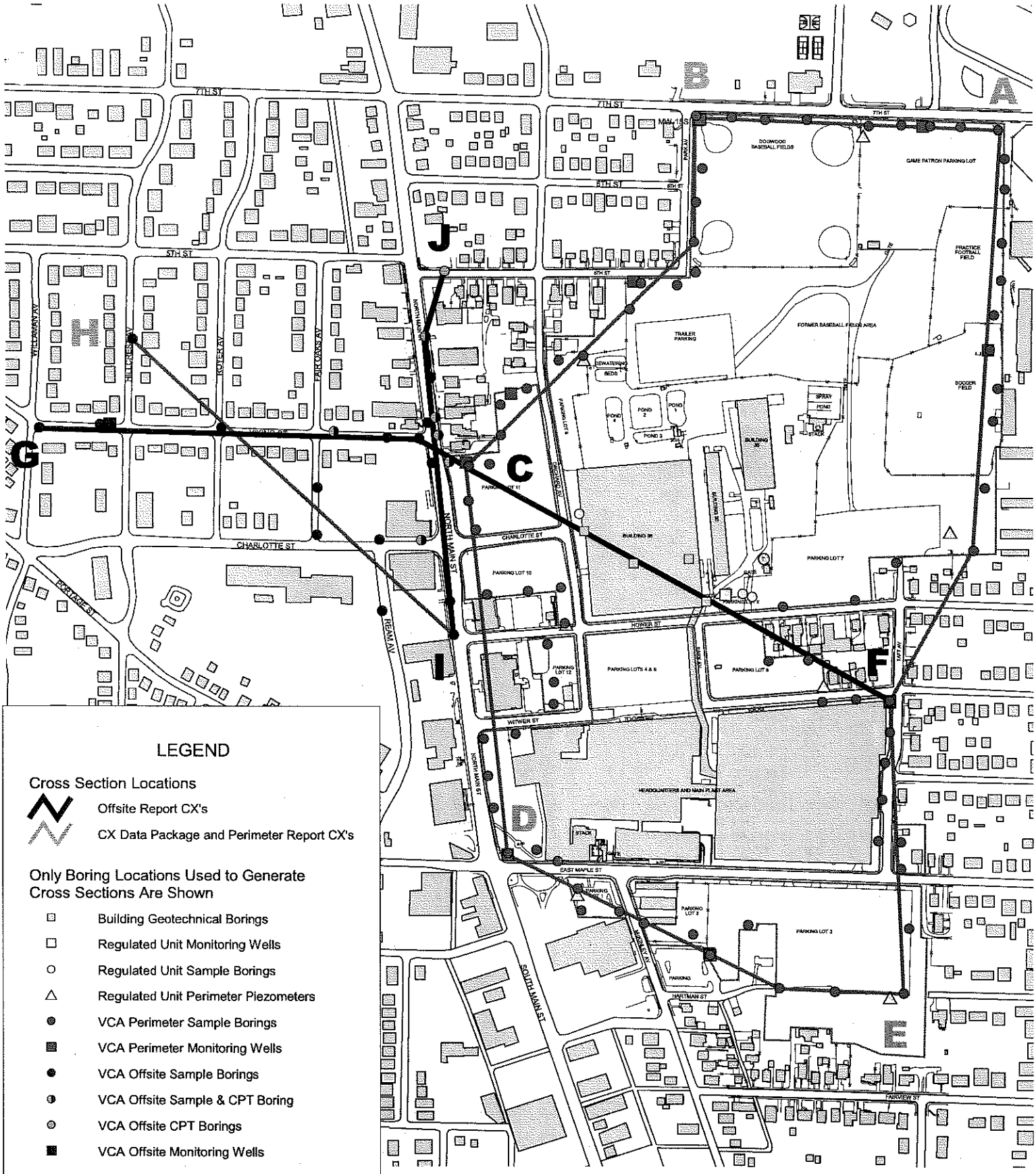
Offsite subsurface conditions are similar to those encountered on the Hoover site, consisting of variable soil types deposited and reworked where glaciers moved over the area thousands of years ago. Subsurface data were collected by drilling soil borings and noting the soil types encountered with depth at each boring location. Soil borings were completed during either the perimeter or offsite investigations at the drilling locations shown in Figure 3-1. Specific information about the Offsite Investigation is provided in *The Hoover Company Offsite Investigation-Soil Boring Drilling and Monitoring Well Construction Data Package* (CH2M HILL 2000d).

Soil material encountered above bedrock is generally referred to as unconsolidated material. For simplification, all unconsolidated material was grouped into one of four units:

- **Coarse-grained unit:** Sand, gravel, or both constitute 95 percent or more of the soil volume.
- **Coarse-grained unit with fine material:** Sand, gravel, or both constitute 50 percent or more of the soil volume.
- **Fine-grained unit**: At least 50 percent fine-grained material (silt or clay) is present by volume. Note that there may be up to 49 percent sand or gravel mixed in with the fine-grained material, but the material as a whole was still assigned to the fine-grained unit.
- **Fill material:** Consists of nonnative material, such as construction debris, engineered fill, industrial fill, and road base. Fill was mainly encountered in perimeter locations.

Bedrock (typically described as shale, siltstone, or sandstone) underlies the unconsolidated material at depths ranging from 10 to at least 60 feet across the Hoover property and offsite areas. Figure 3-2 depicts the estimated shape of the bedrock surface beneath the unconsolidated units. Knowing the bedrock topography is important because sometimes it may influence groundwater movement. The contours in Figure 3-2 show several areas of higher bedrock elevation near the Hoover facility. The primary bedrock high lies beneath the

southeastern part of the Hoover property. A secondary high is situated beneath the northeastern part of the property. Overall, the bedrock elevation decreases west of the facility.



LEGEND

Cross Section Locations

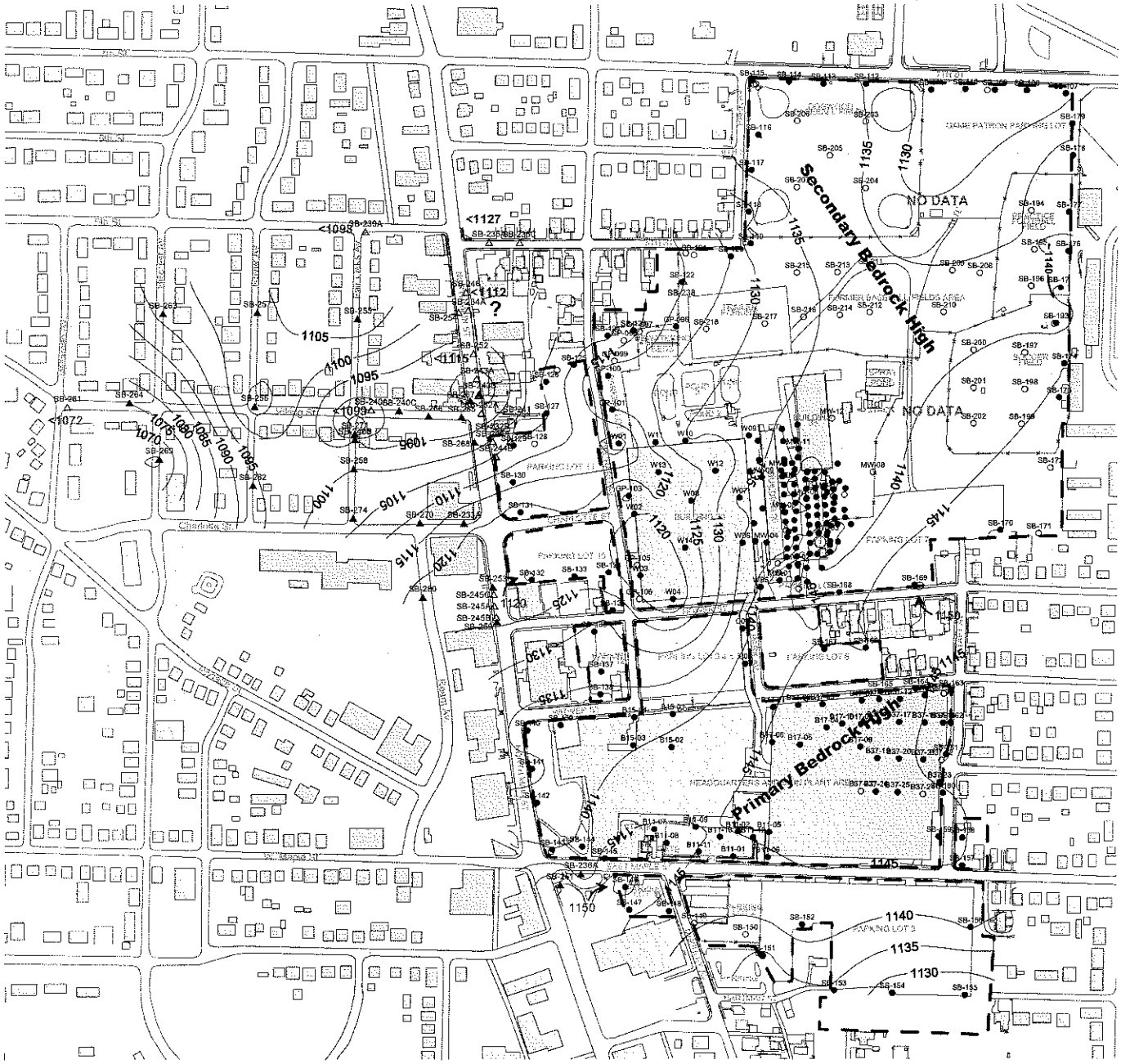
- Offsite Report CX's
- CX Data Package and Perimeter Report CX's

Only Boring Locations Used to Generate Cross Sections Are Shown

- Building Geotechnical Borings
- Regulated Unit Monitoring Wells
- Regulated Unit Sample Borings
- Regulated Unit Perimeter Piezometers
- VCA Perimeter Sample Borings
- VCA Perimeter Monitoring Wells
- VCA Offsite Sample Borings
- VCA Offsite Sample & CPT Boring
- VCA Offsite CPT Borings
- VCA Offsite Monitoring Wells
- 2000 Property Boundary

NOTES:
1. Basemap derived from aerial orthographic photos taken January 17, 2000.
2. Screened-back cross sections are discussed in the RCRA Facility Investigation - Perimeter Investigation Report and the Offsite Investigation Conceptual Cross Section Data Package.

FIGURE 3-1
Cross Section Locations
Offsite Investigation Report
The Hoover Company, North Canton, Ohio



LEGEND

<1099	Maximum bedrock elevation assumed at an offsite boring location not drilled to bedrock
— 1140 —	Estimated bedrock elevation contour (contour interval = 5 feet). Labels are oriented upgradient. Inward hatches indicate depressions.
● ▲	Onsite and Offsite soil boring locations with bedrock data
○ △	Onsite and Offsite soil boring locations without bedrock data
— — —	Approximate Hoover property boundary

North

0 150 300 450 600
Feet

NOTES

1. Elevations reference National Geodetic Vertical Datum of 1988 (NGVD88).
2. Base map derived from orthographic aerial photos taken January 17, 2000.

J:/Hoover/SurfFigs/Offsite_Bedrock.SRF (Plant1bkall_0800.dat) 11/22/00

FIGURE 3-2
Bedrock Topography
Offsite Investigation Report
The Hoover Company, North Canton, Ohio
CH2MHILL

Subsurface information from individual boring logs was combined to produce cross sections of the offsite area and to update the understanding of perimeter and offsite conditions (refer to *The Hoover Company Offsite Investigation – Conceptual Cross Section Data Package* [CH2M HILL 2000e]). The locations of the cross sections developed from perimeter and offsite boring logs are shown in Figure 3-1. Figure 3-3 is a cross section depicting subsurface geologic information along North Main Street (from J to I in Figure 3-1). Figure 3-4 is a cross section depicting geologic information from the west to east along Viking Street and extending onsite across the middle of the facility (from G to F in Figure 3-1).

As shown in Figures 3-3 and 3-4, subsurface conditions beneath the investigation area are variable, which is typical of an environment where glacial deposits are found. The shape of the unconsolidated units varies from long and thin lenses to irregularly shaped, discontinuous zones. The connectivity and shape of these zones becomes important when determining directions for subsurface groundwater movement.

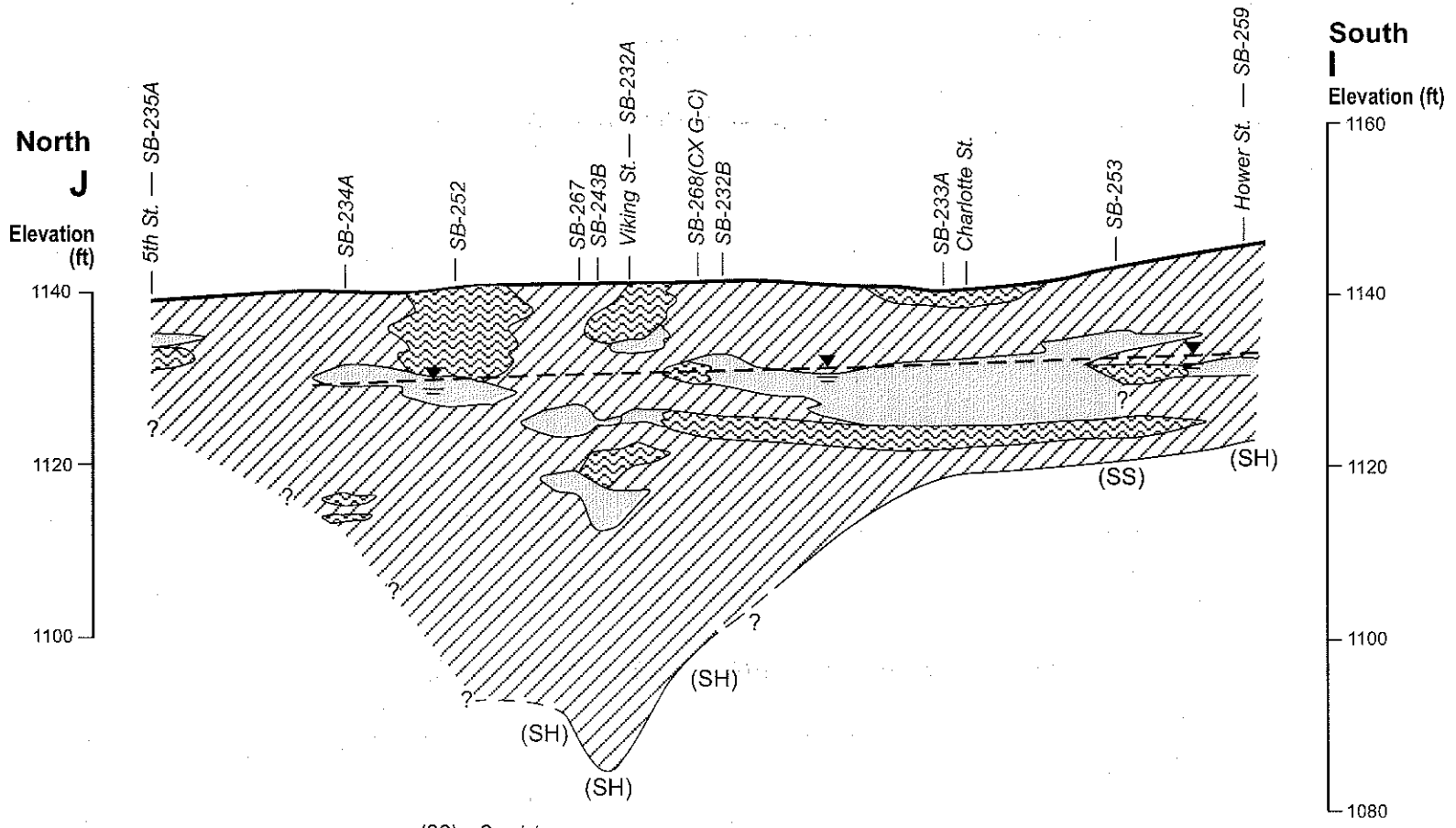
Groundwater Movement

The movement of groundwater can be influenced by the slope of the bedrock, the elevation of the groundwater, and by the material through which the groundwater flows. In general, groundwater tends to move from higher elevation to lower elevation (down hill). This difference in elevation is called a groundwater "gradient." The higher elevation areas are typically referred to as the "upgradient" areas, the lower elevation areas "downgradient." In the investigation area, groundwater flow and rate may be influenced locally by changes in the subsurface materials. For example, the sand and gravel lenses are usually more permeable and, therefore, allow water to pass through more readily than finer grained clay and silt. However, these localized variations in subsurface materials are less noticeable when looking at the overall groundwater flow in the area. This understanding of groundwater movement helps to focus on the area requiring investigation.

Groundwater levels measured in both perimeter and offsite monitoring wells in May 2000 were used to construct a water table and groundwater flow map (Figure 3-5). Water level lines are dashed where the water table was estimated because of the lack of data. Groundwater elevations are also plotted in Figures 3-3 and 3-4.

The observed direction of groundwater flow off of Hoover's property in the Offsite Investigation area is toward the west-northwest, then potentially more westerly (shown by arrows in Figure 3-5). Based on physical and groundwater flow characteristics (refer to *The Hoover Company Offsite Investigation – Hydraulic Characterization Data Package* [CH2M HILL 2000f]) groundwater has the potential to be moving in an offsite direction at a velocity of about 15 to 62 feet per year (Table 3-1).

It is well documented, however, that most chemicals travel more slowly than the groundwater. Movement of chemicals through groundwater is often slowed by physical properties of the individual chemical or soil – a phenomenon called retardation. Depending on its unique makeup, a chemical may tend to adsorb to certain soil types. In addition natural biodegradation processes (such as consumption of the chemical by microbes which results in a breakdown of the chemical) also influence the rate of chemical movement.



LEGEND

x x x Fill

Coarse-Grained Deposits (sand, gravel, sand & gravel)

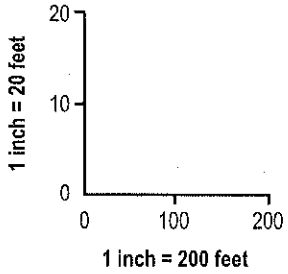
Coarse-Grained Deposits with Fines (sand with silt/clay, gravel with silt/clay, sand/gravel with silt/clay)

Fine-Grained Deposits (silt/clay, silt/clay with sand/gravel)

— ▼ — Inferred Groundwater Elevation based on Extrapolated May 2000 Groundwater Contours or Boring Groundwater Observations

(SS) = Sandstone
(SH) = Shale
(LS) = Limestone

SCALE:

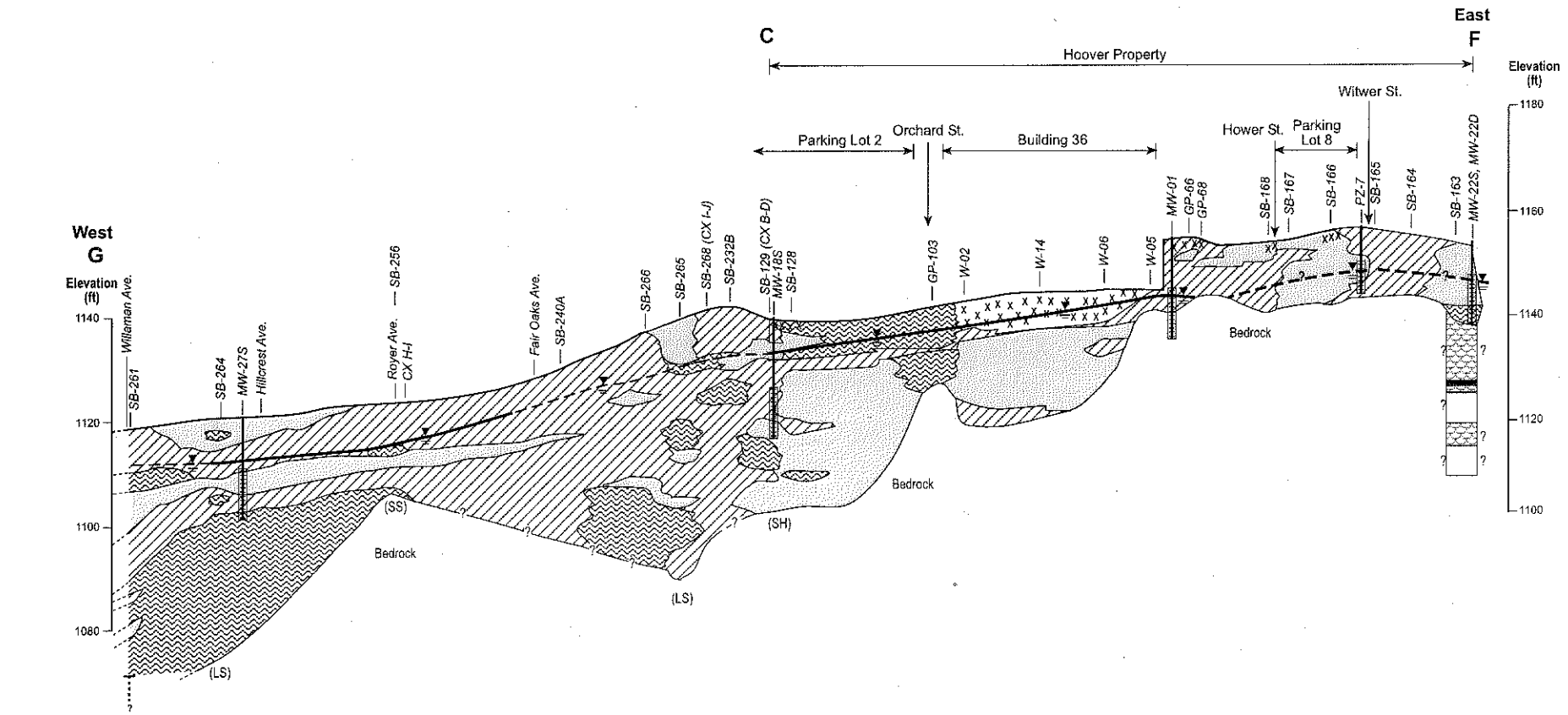


(10 x vertical exaggeration)

Figure 3-3

Cross-Section JI (North Main Street)

Offsite Investigation Report
The Hoover Company, North Canton, Ohio



LEGEND

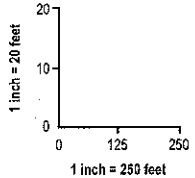
- xxx Fill
- Coarse-Grained Deposits (sand, gravel, sand & gravel)
- Coarse-Grained Deposits with Fines (sand with silt/clay, gravel with silt/clay, sand/gravel with silt/clay)
- Fine-Grained Deposits (silt/clay, silt/clay with sand/gravel)
- Monitoring Well or Piezometer Screened Interval
- Groundwater Elevation Based on May 2000 Groundwater Elevation Contour Map
- Inferred Groundwater Elevation based on extrapolated May 2000 Groundwater Contours or Boring Groundwater Observations

(SS) = Sandstone
(SH) = Shale
(LS) = Limestone

Bedrock Symbols

- Shale
- Coal
- Sandstone
- No Recovery

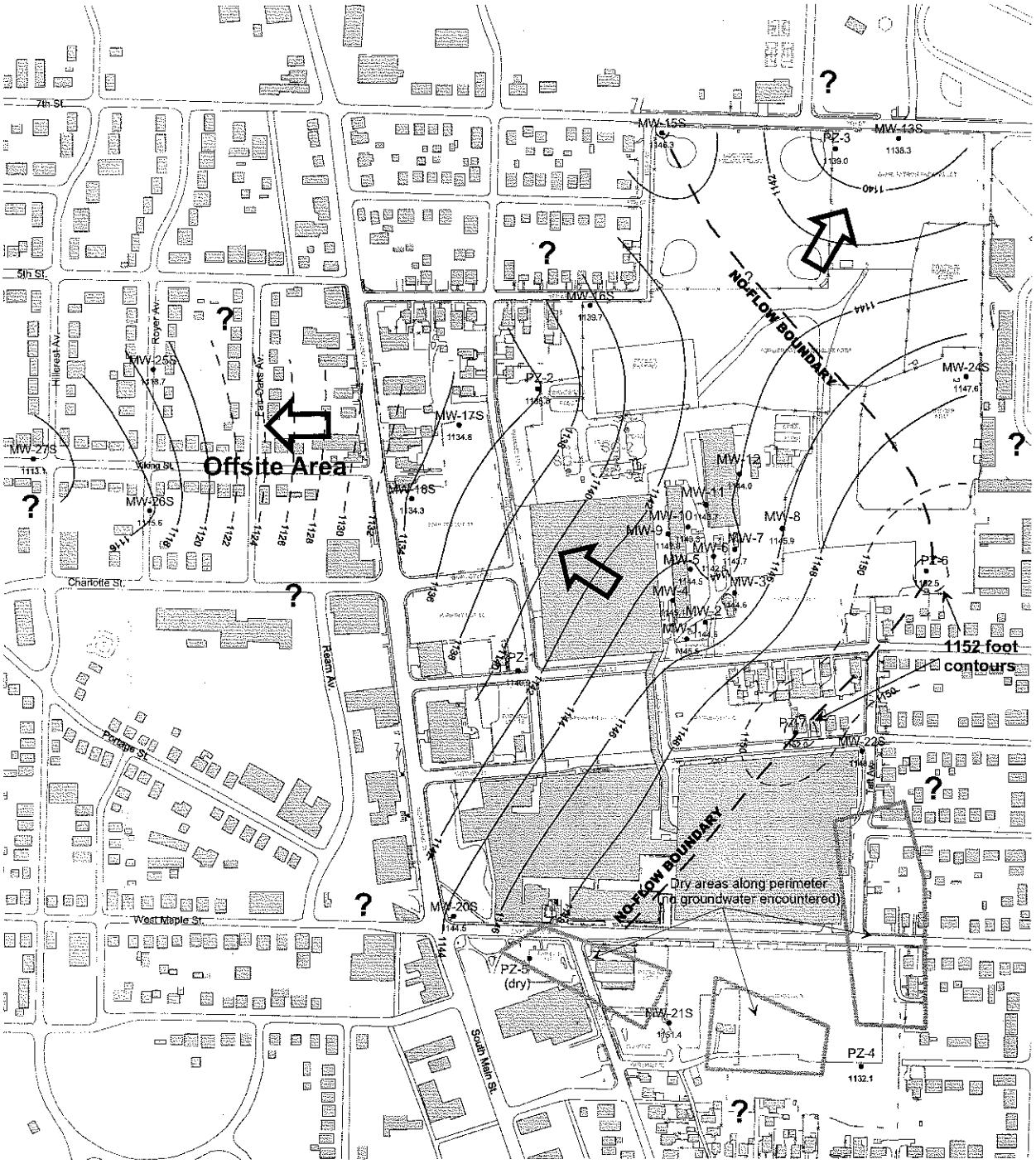
SCALE:



(10 x vertical exaggeration)

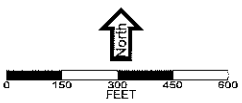
NOTES:
1. Elevations in feet above mean sea level are based on mean sea level data during 1980's (National Geodetic Vertical Datum of 1988).
2. The depth and thickness of the subsurface materials shown on the section (profile) were generalized from and interpolated between test borings. Information on actual subsurface conditions exists only at the specific locations and dates indicated. Soil (rock) conditions and water levels at other locations may differ from conditions occuring at the boring locations. Also, the passage of time may result in a change in the conditions at these boring locations.

Figure 3-4
Hydrogeological Cross-Section GF (Viking Street and Facility Center)
Offsite Investigation Report
The Hoover Company, North Canton, Ohio



LEGEND

MW-18S ●	Facility Piezometer (PZ), Staff Gauge (SG), and Monitoring Well (MW) identifier and location with groundwater elevation (in feet above mean sea level)
1142	Groundwater surface elevation (feet) and contour
	Inferred groundwater contour (shown only to illustrate the effect of the bedrock high on the groundwater elevations)
	General groundwater gradient direction
?	Groundwater surface elevation unknown
	Approximate property boundary



NOTES

1. All monitoring wells and piezometers, but none of the staff gauges, were used in interpreting the groundwater surface. Groundwater contours assume the ponds north of Building 36 do not significantly impact groundwater levels or flow direction.
2. Elevations reference National Geodetic Vertical Datum of 1988 (NGVD88).
3. Base map derived from orthographic aerial photos taken January 17, 2000.
4. Onsite groundwater data was collected on May 9, 2000. Offsite groundwater data was collected on May 18, 2000.

Antigone/Proj(j:)hoover/sur/figs/Offsite_GW.srf (fgwelev0500.dat) 11/15/00

FIGURE 3-5

May 2000 Groundwater Surface Contours and Gradients

Offsite Investigation Report
The Hoover Company, North Canton, Ohio

CH2MHILL

TABLE 3-1
Average Offsite Groundwater Velocity Calculation
The Hoover Company

To calculate average groundwater velocity, use the equation

$$V = ki/n$$

where:

Velocity (V) = The average horizontal rate of groundwater flow

Groundwater gradient ("i" or the slope of the groundwater table, measured in ft of 'rise' over ft per 'run') = 0.017 ft/ft (based on the May 2000 groundwater elevations)

Hydraulic conductivity ("k" or the rate at which groundwater can move through permeable subsurface material) = 0.5 to 2 ft per day[1]

Effective porosity ("n" or the ratio of the volume of void spaces through which water or other fluids can travel in a permeable media divided by the total volume of that media = 20%[2]

Solving the equation for (V) yields a range of 0.04 to 0.17 ft per day (15.5 to 62 ft per year).

[1]0.5 ft per day is the average of offsite slug tests performed at MW25S, MW26S, and MW27S. 2 ft per day is the average of slug and pump tests performed at perimeter locations MW17 and MW18.
[2]The average of porosity measured from geotechnical samples at SB-118, SB-122, SB-126, and SB-129 was 37%. The estimated effective porosity for the soils types samples is 20% (after Sanders 1998).

Underground Utilities and Groundwater Movement

An underground utility can influence groundwater movement if the utility is below the water table and if groundwater is able to flow more readily through the backfill surrounding the utility as compared to the surrounding soil. Based on the comparison of utility depths obtained from the City of North Canton Department of Engineering and depths to groundwater from this investigation, the water, gas, and electric utilities and storm sewers are all above groundwater level. Therefore, they are not considered to be potential pathways for the migration of groundwater. In certain areas, most notably beneath North Main Street near Viking Street (refer to *The Hoover Company Offsite Investigation-Utilities Evaluation Data Package,* CH2M HILL 2000g) the sanitary sewer lines likely occur below the water table. Therefore, they could act as pathways for the migration of groundwater. This topic is discussed further under "Utility Survey."

Contaminant Distribution in Groundwater

Some groundwater sample results along Hoover's western property boundary exceeded target levels (see Section 2 for a description of how target levels are defined). These exceedances prompted further groundwater investigation off Hoover's property in the direction of groundwater flow (estimated to be toward the west-northwest; Figure 3-5). For the Offsite Investigation, groundwater grab samples were collected in City of North Canton rights-of-way for specific chemicals on the Target Analyte List, described in Section 2. The groundwater samples were usually collected from two depths at each soil boring location. The depths were typically at the water table surface (generally 6 to 15 feet below ground) and near the bedrock surface (20 to 50 feet below ground).

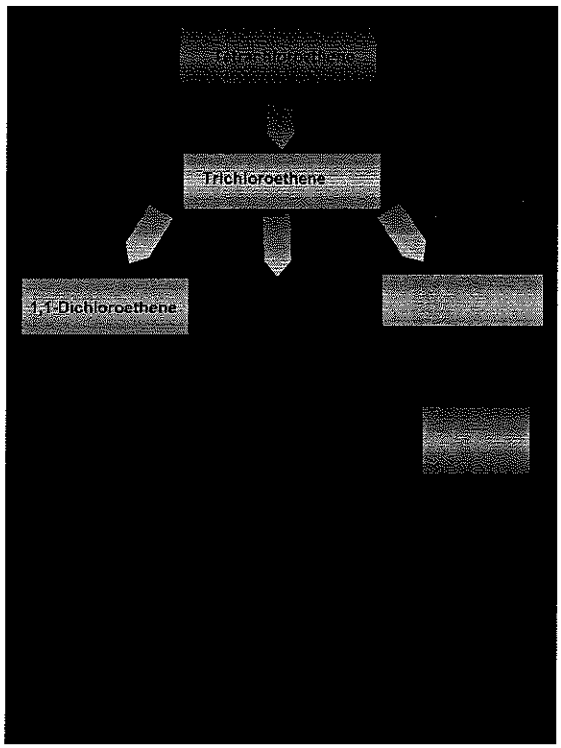
The chlorinated volatile organic compounds (CVOCs) are the focus of the Offsite Investigation compared to the semivolatile organic compounds (SVOCs) and metals for the

following reasons. First, because of their chemical properties, CVOCs are able to dissolve in and move through groundwater much more readily than SVOCs and metals. Second, CVOCs are more volatile than SVOCs or metals and have the potential to migrate from groundwater into buildings as a gas, thus creating an additional potential exposure pathway that does not exist for SVOCs and metals.

Additional information about SVOCs and metals are contained in *The Hoover Company Offsite Investigation – Groundwater Evaluation for bis(2-Ethylhexyl)phthalate, 2-Methylnapthalene, and Naphthalene* (CH2M HILL 2000h) and *The Hoover Company Offsite Investigation – Metals Analytical Results in Groundwater* Technical Memorandum (CH2M HILL 2000i). Summaries of SVOC and metal analytical data are provided in Appendix E and also in *The Hoover Company Offsite Investigation – Field and Laboratory Data Summary Package* (CH2M HILL 2000j).

Groundwater Concentrations vs. Target Levels

CVOCs exceeded target levels in nine perimeter borings and ten Offsite Investigation borings (Figure 3-6). Table 3-2 summarizes the maximum CVOC concentrations observed for each sampled location within the investigation area where a target level was exceeded. In general, offsite CVOCs occurred downgradient from CVOCs detected in perimeter borings. Overall, the sample locations that exceeded target levels (locations with colored panes in Figure 3-6) are surrounded on the downgradient side by locations in which no target levels are exceeded (locations with clear panes in Figure 3-6), which means the extent of chemicals at or above the target levels has been determined. The maximum distance from Hoover property that a target level was exceeded was about 800 feet to the west (at SB-256) and 350 feet to the northwest (at SB-254).



The combined presence of PCE, TCE, cis-1,2-DCE, and vinyl chloride demonstrate that the PCE is breaking down in the environment in accordance with the typical natural degradation of CVOCs (Figure 3-7). In addition, there is a group of locations near Parking Lot 11 (near the intersection of North Main and Viking streets) in which only vinyl chloride and cis-1,2-DCE exceeded CVOC target levels. North of that group is a smaller group of three locations (SB-125, SB-126, and SB-254) in which only PCE and TCE exceeded CVOC target levels. In the vicinity of North Main and Charlotte streets, PCE, TCE, and cis-1,2-DCE exceeded target levels at another group of locations. These observations are important because they suggest that the CVOCs may be undergoing varying amounts of natural degradation.

TABLE 3-2
CVOC Concentrations Exceeding Target Levels
The Hoover Company

Location*	Maximum CVOC Concentration (µg/L)			
	PCE (TL = 5 µg/L)	TCE (TL = 5 µg/L)	cis-1,2-DCE (TL = 70 µg/L)	Vinyl Chloride (TL = 2 µg/L)
SB-125	17	6.2	BTL	BTL
SB-126	BTL	21	BTL	BTL
SB-127	BTL	BTL	390	42[b]
SB-128	BTL	BTL	1,200	270[b]
SB-129	BTL	BTL	4,900	1,400[b]
SB-132	15	32	86	BTL
SB-133	190[a]	350[b]	320	BTL
SB-134	760[b]	680[b]	960	BTL
SB-135	BTL	340[b]	410	BTL
SB-232A	BTL	BTL	BTL	21[b]
SB-232B	BTL	BTL	2,600	300[b]
SB-236A	BTL	BTL	BTL	5.7[a]
SB-240A	BTL	BTL	390	BTL
SB-253	BTL	9.6	BTL	BTL
SB-254	6.3	BTL	BTL	BTL
SB-256	BTL	BTL	450	BTL
SB-265	BTL	BTL	BTL	130[b]
SB-268	BTL	BTL	4,300	920[b]
SB-270	BTL	6.4	BTL	BTL

TL = target level. BTL = not detected at or above target level.
The maximum concentrations at each location is presented in this table.
[a]Also exceeds the nonpotable groundwater use and the groundwater direct to indoor air decision levels.
[b]Also exceeds the nonpotable groundwater use, the groundwater direct to indoor air, and groundwater-to-soil gas decision levels.

At SB-236A near North Main and East Maple streets, there is an isolated exceedance of the target level for vinyl chloride. This occurrence is considered "isolated" because exceedances of vinyl chloride were not detected above the target level in any of the surrounding sample locations, including within Hoover's perimeter.

Groundwater Concentrations vs. Decision Levels

The sample concentrations that exceeded target levels were further evaluated to determine if specific decision levels were exceeded. Decision levels are concentrations of chemicals that are protective of human health under a given exposure pathway scenario. The primary pathways evaluated are the nonpotable groundwater use pathway and the groundwater to indoor air pathway.

Decision Levels for Nonpotable Groundwater Use Pathway

Locations where groundwater sample concentrations exceeded nonpotable groundwater use decision levels ("nonpotable decision levels") are shown in Figure 3-8. During the Offsite Investigation, 9 of 52 samples (representing 5 different sample locations) exceeded the nonpotable decision level concentrations. Note that Figure 3-8 shows both the offsite and nearby perimeter sample locations to allow for the comparison of data collected during both investigations. Three of those locations (SB-232A, SB-265, SB-268) were in a limited offsite area near the intersection of Main and Viking streets where vinyl chloride was the only CVOC found above the decision level. The fourth location, SB-232B, was actually located on Hoover property. Nonpotable decision level exceedances were not detected downgradient of the intersection of Main and Viking streets, demonstrating that the extent of groundwater migration with these concentrations remains fairly close to the Hoover property boundary in this area. The fifth location, SB-236A, was the isolated occurrence of vinyl chloride discussed in the target level section.

Because decision levels were exceeded at these locations, a pathway evaluation was conducted to further evaluate potential for risk, and is provided later in this section under the heading "Survey of Residences and Businesses."

Decision Levels for Groundwater to Indoor Air Pathway

The groundwater sample data collected at Hoover's perimeter and at offsite locations were evaluated to determine the potential for chemicals in the groundwater to volatilize into the soil gas (air between soil particles) and then to indoor air at concentrations that could be of concern. To accomplish this, the groundwater sample results were compared against the groundwater-to-soil-gas decision levels.

Concentrations in groundwater grab samples exceed decision levels for groundwater to soil gas in two areas (Figure 3-9). During the Offsite Investigation, 8 of 52 samples (representing 4 different locations) exceeded the groundwater-to-soil-gas decision levels. Note that Figure 3-9 shows both the offsite and nearby perimeter sample locations to allow comparison of data collected during both investigations. These locations (SB-232A, SB-232B, SB-265, and SB-268) are in a limited offsite area near the intersection of Main and Viking streets, where vinyl chloride was the only detectable CVOC found above the decision level. Groundwater-to-soil-gas decision level exceedances did not occur downgradient of the intersection of Main and Viking streets (SB-265), demonstrating that the migration of groundwater at these concentrations remains close to the Hoover property boundary.

At sample locations where the decision level was exceeded, soil gas sampling was considered to directly measure chemical concentrations in that media. Soil gas samples were collected at 5 locations (SB-241, SB-232A, SB-232B, SB-272, and SB-273) during the Offsite Investigation. These sample locations were chosen because (1) they were immediately adjacent to or nearby groundwater decision level exceedances; (2) they represented locations that had the greatest likelihood of exceeding the soil-gas-to-indoor-air decision level (for example, SB-129 had the highest concentration of vinyl chloride of any perimeter or offsite groundwater sample); or (3) collectively, they represent all the different CVOCs that exceeded the groundwater-to-soil-gas decision level (refer to *The Hoover Company Offsite Investigation – Soil Gas Sampling Summary* [CH2M HILL 2000k]).

Although CVOCs were detected in groundwater at concentrations exceeding groundwater-to-soil-gas decision levels (Table 3-3), there is little to no transfer of CVOCs from groundwater into soil gas (Table 3-4). Figure 3-10 presents the relationship between groundwater-to-soil-gas decision level exceedances and actual soil gas results. Comparing Figure 3-10 with Figure 3-9 further shows that soil gas samples were collected in the same areas where groundwater-to-soil-gas decision levels were exceeded. These findings provide strong evidence that the groundwater-to-indoor air pathway is incomplete and that soil gases with concentrations of concern are not migrating into buildings. Therefore further evaluation of this pathway is unnecessary.

TABLE 3-3
Comparison of Soil Gas to Groundwater Grab Sample Results
The Hoover Company

Chlorinated Volatile Organic Compound	Groundwater-to-Soil-Gas Decision Level	Adjacent Sampling Location Groundwater SB-232A (15 to 20 ft)	Adjacent Sampling Location Soil Gas SB-232A (7 to 8 ft)	Adjacent Sampling Location Groundwater SB-232B (8 to 12 ft)	Adjacent Sampling Location Soil Gas SB-232B (7 to 8 ft)
cis-1,2-DCE	11,500	< 70	< 0.004	2500	0.04
PCE	360	< 5	< 0.007	< 5	< 0.007
TCE	190	< 5	< 0.005	< 5	0.003
Vinyl Chloride	8	**21**	< 0.003	**290**	< 0.003

Chlorinated Volatile Organic Compound	Adjacent Sampling Location Groundwater SB-129 (10 to 15 ft)	Adjacent Sampling Location Soil Gas SB-241 (4 to 5 ft)	Adjacent Sampling Location Groundwater SB-132 (14 to 16 ft)	Adjacent Sampling Location Soil Gas SB-272 (6.5 to 7.5 ft)	Adjacent Sampling Location Groundwater SB-135 (10 to 20 ft)	Adjacent Sampling Location Soil Gas SB-273 (6 to 7 ft)
cis-1,2-DCE	4900	< 0.008	< 70	0.008	410	0.008
PCE	< 5	< 0.014	15	1.317	< 5	0.01
TCE	< 5	< 0.011	30	0.654	**340**	0.08
Vinyl Chloride	**1400**	< 0.005	<2	< 0.006	<2	< 0.003

All concentrations are µg/L.
"<" = below detection level concentration indicated
All sample depths are indicated in feet (ft) below ground.
Bold values exceed the groundwater-to-soil-gas decision level

TABLE 3-4
Comparison of Soil Gas Results to Soil Gas to Indoor Air Decision Level
The Hoover Company

Chlorinated Volatile Organic Compound	Soil Gas to Indoor Air Decision Level	Soil Gas Result				
		SB-241	SB-232A	SB-232B	SB-272	SB-273
cis-1,2-DCE	970	*< 0.008*	*< 0.004*	0.04	0.008	0.008
PCE	50	*< 0.014*	*< 0.007*	*< 0.007*	1.317	0.01
TCE	16	*< 0.011*	*< 0.005*	0.003	0.654	0.08
Vinyl Chloride	2.5	*< 0.005*	*< 0.003*	*< 0.003*	*< 0.006*	*< 0.003*

All concentrations are µg/L. "<" = below detection level concentration indicated
All sample depths are indicated in ft below ground.

The distribution of groundwater concentrations that exceeded the direct groundwater to indoor air decision level is exactly the same as for the nonpotable decision level (Figure 3-8).

Survey of Residences and Businesses

At the beginning of the Offsite Investigation, it was unknown whether any residents or workers in homes or businesses have or use private wells on their property or experience groundwater intrusion into basements. Because CVOCs were detected at some offsite groundwater sampling locations at concentrations exceeding decision levels, a survey of residents and businesses adjacent to and near those sample locations was performed. Survey areas are summarized in Table 3-5. Locations of survey areas and the buildings contained therein are shown in Figure 3-11.

Based on the survey results (*The Hoover Company Offsite Investigation-Survey of Residences and Businesses*, CH2M HILL 2000l), there is no evidence of current exposure to groundwater in buildings within or downgradient of those areas where CVOCs in groundwater exceed decision levels, except for the fire station. In terms of risk, this indicates that there is no complete pathway (ingestion of or direct contact with groundwater) that would pose potential risk to human health. For the fire station, there is a potentially complete groundwater exposure pathway via the sump in the basement. However, potential exposure to contaminated groundwater in the fire station is unlikely to be significant based on the estimated concentration of the chemicals and the limited frequency and duration of exposure (*Documentation of Investigative Decision Levels for the Offsite Groundwater Investigation*, CH2M HILL 2000m).

Utility Survey

Parts of the sanitary sewers lie beneath the water table. Therefore, there is a potentially complete pathway by which a utility worker could come in contact with contaminated groundwater. However, using the maximum chemical concentrations detected in offsite groundwater, potential exposure to chemicals in groundwater is unlikely to be significant based on those concentrations and the limited frequency and duration of exposure.

TABLE 3-5
Summary of Survey of Residences and Businesses
The Hoover Company

Survey Area*	Structures and Justification	Results
Area A—South of Viking Street and East of Fair Oaks Avenue	Four buildings located between SB-268 and SB-271 are downgradient of SB-268 where decision levels for nonpotable groundwater were exceeded in SB-268. No CVOCs were detected in SB-271, limiting the downgradient area of the survey in this location.	The buildings do not have wells. All buildings have basements. One building reported an occasional wet basement, but elevation surveying data suggest water table is below bottom of basement and moisture is likely related to condensation or rainwater leaking into the basement.
Area B— North of Charlotte Street and West of N. Main Street	The building in this area was selected because it is hydraulically downgradient of SB-132 and SB-253 (Figure3-5), where CVOC target levels were exceeded.	The building does not have a well. The building does not have a basement.
Area C—North of Hower Street Between N. Main Street and Orchard Avenue	The building located near the corner of Hower Street and Orchard Avenue was chosen because it is immediately downgradient of SB-135, where the decision level for TCE was exceeded. A potential groundwater exposure survey was also performed at the fire station for a similar reason.	The buildings do not have wells. Both buildings have basements. One building reported an occasional wet basement, but elevation surveying data suggest water table is below bottom of basement and moisture is likely related to condensation or rainwater leaking into the basement. The fire station has a sump which runs intermittently and keeps the basement dry.
Area D—Between N. Main Street and Parking Lot No. 11.	Group of four buildings downgradient of SB-125, SB -126, SB -127, SB -128, and SB -129 where nonpotable groundwater decision levels were exceeded.	The buildings do not have wells. Three of the four buildings have basements. One building reported wet basement after rainfall events. This is considered to be related to poor drainage rather than groundwater seepage.
Area E—North of Viking Street Between Fair Oaks Avenue and N. Main Street (Area E)	A group of six buildings downgradient of SB-323A and SB-265 where non-potable groundwater decision levels were exceeded. No decision levels were exceeded in borings farther downgradient which limited the extent of the survey in this area.	The buildings do not have wells. All buildings but one have basements. Three report wet basements, one of which is related to rainfall. Elevation survey data suggest water table is below bottom of basement and moisture likely related to condensation or rainwater leaking into the basement.

*Refer to Figure 3-11 for identification of the areas discussed in this table.

Summary and Conclusions

The results of this investigation were used to characterize the extent of contaminated groundwater beyond Hoover's western property boundary and to evaluate whether existing conditions in the Offsite Investigation area pose concerns about human health. While the results show that contaminated groundwater is present in limited offsite areas, the evaluation of the results shows that there are currently no significant human health risks associated with groundwater that is migrating off Hoover's western property boundary.

Specific conclusions, which fit into one of two categories regarding the nature and extent of the onsite and offsite contamination or regarding preliminary assessment of risk associated with the contamination, are summarized below.

Nature and Extent

- Groundwater flows away from the property, mostly toward the west and northwest.
- PCE is present in groundwater beneath parts of the Hoover property.
- PCE and three of the biodegradation byproducts (TCE, cis-1,2-DCE, and vinyl chloride) were detected at concentrations exceeding target or decision levels along part of Hoover's western property boundary near the intersection of North Main Street and Viking Street and along Hower Street between Orchard and North Main streets.
- The presence and distribution of these CVOCs in groundwater in these areas shows that they have migrated, to a limited extent, offsite in the same general direction as groundwater flow and are naturally degrading in the environment.
- The downgradient extent of contamination has been defined relative to target levels.
- The chemical makeup of the groundwater near Hower Street differs from that near the intersection of North Main Street and Viking Street. PCE and TCE are the predominant CVOCs exceeding target and decision levels near Hower Street. Vinyl chloride and cis-1,2-DCE are the predominant CVOCs exceeding target levels and decision levels near the other area. Vinyl chloride and cis-1,2-DCE are later stage biodegradation byproducts of PCE, suggesting that more aggressive biodegradation is occurring in that area.
- The sanitary sewers may have an affect on groundwater movement.

Assessment of Risk

Activities performed during the Offsite Investigation near the Hoover facility have provided data to determine that there are only two potentially complete exposure pathways. The data collected during investigation activities that support this conclusion are summarized as follows:

- While SVOCs were detected at concentrations greater than target levels, they were never detected at concentrations exceeding decision levels. Dissolved metals exceeded nonpotable decision levels in only two locations and do not pose a health risk because of incomplete nonpotable pathway (described below).

- Target levels of CVOCs are exceeded at limited locations in the groundwater at the western perimeter of the Hoover property and offsite in a downgradient direction. Target levels are related to drinking water standards. Since no one drinks groundwater from the areas where target levels were exceeded, there is not a complete pathway.
- The nonpotable groundwater decision levels are exceeded at locations that straddle the western facility boundary. Since there are no water supply wells at the homes and businesses within and downgradient of these areas, there is not a complete pathway.
- With the exception of a single location (the fire station at the corner of Hower and North Main streets) groundwater is not entering any buildings. Therefore, that pathway also is incomplete. In the case of the fire station, groundwater may be present in a basement sump. However, potential exposure to chemicals in groundwater from fire station sump is unlikely to be significant based on the limited frequency and duration of exposure.
- Sanitary sewer utility workers might be exposed to chemicals in groundwater (either by direct contact or incidental ingestion) if it enters the sewer trench backfill and workers come into contact with affected groundwater. However, potential exposure to chemicals in groundwater in the utility excavation is unlikely to be significant based on observed chemical concentrations and the limited frequency and duration of exposure.
- Samples collected from soil gas indicate that the transfer of CVOCs from groundwater to soil gas is insignificant. If chemicals are not migrating through the soil gas, they cannot migrate into buildings. Based on these observations, a complete exposure pathway does not exist.

References

CH2M HILL. The Hoover Company RCRA Facility Investigation, *Perimeter Investigation Report*. 2000a.

CH2M HILL. The Hoover Company *Facility-Specific Target Levels- Hoover Voluntary Corrective Action Program. Memorandum.* 2000b.

CH2M HILL. The Hoover Company Offsite Investigation - *Documentation of Investigative Decision Levels for the Offsite Groundwater Investigation*. 2000c.

CH2M HILL. The Hoover Company Offsite Investigation - *Soil Boring Drilling and Monitoring Well Construction Data Package*. 2000d.

CH2M HILL. The Hoover Company Offsite Investigation – *Conceptual Cross Section Data Package*. 2000e.

CH2M HILL. The Hoover Company Offsite Investigation – *Hydraulic Characterization Data Package*. 2000f.

CH2M HILL. The Hoover Company Offsite Investigation – *Utilities Evaluation Data Package*. 2000g.

CH2M HILL. The Hoover Company Offsite Investigation – *Groundwater Evaluation for bis (2-Ethylhexyl) phthalate, 2-Methylnapthalene, and Naphthalene Data Package*. 2000h.

CH2M HILL. The Hoover Company Offsite Investigation – *Metals Analytical Results in Groundwater* Technical Memorandum. 2000i.

CH2M HILL. The Hoover Company Offsite Investigation – *Field and Laboratory Data Summary Package*. 2000j.

CH2M HILL. The Hoover Company Offsite Investigation – *Soil Gas Sampling Summary Data Package*. 2000k.

CH2M HILL. The Hoover Company Offsite Investigation - *Survey of Residences and Businesses Data Package*. 2000l.

CH2M HILL. *Documentation of Environmental Indicator Determination*. 2000m.

CH2M HILL. The Hoover Company RCRA Facility Investigation – *Offsite Investigation Work Plan and Sampling and Analysis Plan*. 2000n.

CH2M HILL. The Hoover Company Offsite Investigation – *Field Activities and Work Plan/SAP and SOP Modifications*. 2000o.

Sanders, Laura A. *A Manual of Field Hydrology*. Prentice-Hall, Inc. 381 pages. 1998.